

better methods of feeding." The importance of sufficient food is emphasised, but the author might have dealt even more fully with this point. As the dairy industry advances, cowkeepers increase their rations, until, in districts where the industry is very highly developed, as in many parts of the home counties, they tend to give too much food for profitable milk production.

It has been shown by experiment that an increase in the quantity of the ration leads to an increased production of milk, but the return obtained per unit of food becomes less and less, and finally is not worth as much as the food costs.

The great difficulty about dairy farming in the States seems to be the labour supply. "The special objections raised to the labour on the dairy farm are the long hours, the steady, regular work, and the nature of the work." The same difficulty is felt in British agriculture, and to meet it machinery is being invented. Strenuous efforts are being made to perfect the cow-milking machine, which will considerably ease matters.

E. J. RUSSELL.

ALGEBRAIC NUMBERS.

The Elements of the Theory of Algebraic Numbers. By Prof. L. W. Reid. With an introduction by Prof. D. Hilbert. Pp. xix + 454. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 15s. net.

IT is almost a misfortune that Gauss and Smith were such consummate masters of mathematical style. Nearly everyone who writes on an arithmetical topic is tempted to imitate them, at least in their brevity and severe deductive method, and the result is that many are frightened away from a delightful study because of its dry and, so to speak, inaccessible aspect.

Prof. Reid's book ought to do much to remove this misapprehension; he has assumed no previous knowledge of the subject beyond elementary arithmetic, and he has been careful to give a very large number of special examples, as well as discussions of special fields. Thus the reader is able to see, much more than is usually possible, the really inductive character of arithmetical research, and is provided with material on which he may make experiments of his own.

As an introduction to the general theory of algebraic numbers, the work follows mainly the treatment of Hilbert and Dedekind; the principal difference from the latter being that, for instance in a quadratic field, an ideal (α, β) is (ultimately) defined as the aggregate of integers $\lambda\alpha + \mu\beta$, where λ, μ are any two integers in the field, and α, β are given integers therein. This saves a good deal of rather delicate reasoning, necessary if Dede-

kind's own definition of an ideal is adopted, and detracts little, if anything, from the naturalness of the sequence of theorems.

After four chapters dealing with the ordinary rational theory (including the law of quadratic reciprocity), we have four others, each devoted to a special quadratic field, namely, those derived from $\sqrt{-1}$, $\sqrt{-3}$, $\sqrt{2}$, $\sqrt{-5}$ respectively. In the last of these it is made perfectly clear how the law of resolution into prime factors appears to break down, and how it is restored by the introduction of ideals. Moreover, examples are given to show the distinction, in this field, between principal and non-principal ideals.

The next four chapters give general theorems on algebraic numbers, a discussion of the general quadratic field, its discriminant and ideals, and the theory of congruences with respect to ideal moduli in such a field.

Finally, there are two chapters, of a rather more advanced kind, on the units of the general quadratic field, and on the number of its ideal classes. In the latter use is made of Minkowski's remarkable theorem that every ideal class contains an element whose norm does not exceed $|\sqrt{d}|$, where d is the discriminant of the field. Prof. Reid has elsewhere published a list of classes of cubic fields calculated on the same principle; but the work is tentative and laborious, and it is still a desideratum, even for cubic fields, to determine, by some simple method, the fundamental units and representatives of each ideal class. Fortunately, however, in working with an ideal, any one of its forms will do in using it as a modulus, finding its prime factors, and so on: just as (6, 9) or (6, 9, 27) define 3 (as a greatest common measure) just as well as 3 itself for purposes of this kind.

It is very gratifying to see that the higher arithmetic is attracting more and more attention, and it is certain that books like Prof. Reid's will greatly help to popularise "the queen of the sciences," as Gauss so affectionately called it.

G. B. M.

A HISTORY OF EUROPEAN CULTIVATED PLANTS AND DOMESTIC ANIMALS.

Kulturpflanzen und Haustiere in ihrem Uebergang aus Asien nach Griechenland und Italien sowie in das übrige Europa. Historisch-linguistische Skizzen von Victor Hehn. Achte Auflage. Neu herausgegeben von O. Schrader. Mit botanischen Beiträgen von A. Engler und F. Pax. Pp. xxviii + 665. (Berlin: Gebrüder Borntraeger, 1911.) Price 17 marks.

VICTOR HEHN'S book, the result of years of labour, first appeared in 1870. A second edition was called for in 1874, to which the essay

on the horse was added, and in which replies to critics fill most of the preface. A third edition was issued in 1877, a fourth in 1883, and a fifth in 1887. Hehn died on March 21, 1890, leaving his book in the hands of Prof. O. Schrader, editor-in-chief of the three editions which have appeared since that date.

The work opens with a long extract from the preface to the sixth edition, from which the above particulars have been taken. In nearly a quarter of a century (1870-94) knowledge had increased greatly, and many additions and corrections were necessary. Herr Schrader addressed himself to his task on the lines laid down by De Candolle. To cope with the botanical work became the duty of Prof. Engler, assisted later by Prof. Pax, of Breslau. With regard to the sections treating of domestic animals, the editor called in the help of Prof. A. Nehrings. The general revision and philology were Prof. Schrader's special care; but he is very ready to acknowledge help received from Dr. Kurt Muller, Dr. Hugo Prinz, and others.

All additions and corrections are placed, in small type, at the end of each essay. The adoption of this plan was no doubt due to respect for Hehn's work. Even then the method is a bad one, and the present writer cannot see anything in Hehn's original text to warrant such respect. To a reader coming fresh to the book it is somewhat irritating, and causes waste of time. The writer of this notice worked carefully through the essay on the horse, making critical notes, only to find that the editors had made all necessary corrections in their notes placed at the end of the section. Articles dealing with domestic animals are scattered about among those dealing with cultivated plants. No fewer than ninety-nine pages are occupied by original "notes"—pp. 531-629. This adds another drawback to the work. Either the reader must turn away from the page to the "note" at once, breaking the thread of attention, or the "notes" must be left to be read later, when it may easily happen that the point referred to is not clearly remembered. The book contains a good table of contents and a satisfactory index.

In the introduction we get a record of the good and harm that man may work upon virgin soil. The early Aryan invasion found Greece thickly forested and with a fruitful soil. Much harm was subsequently done by exhaustive cultivation and destruction of forest. Such ruined areas recovered partly when deserted, often to pass through similar stages as is recorded by Fraas, in 1847, of parts of the peninsula. About one hundred culti-

vated plants are dealt with, the most important being the vine, olive, fig, citrons, plums, almonds, flax, hemp, maize, rice, and tobacco. Of the domestic animals—a more limited class—an almost complete account is given. In the original text, and in all subsequent additions, the authority for borrowed statements is given with scrupulous care. If genius is taking pains—a definition ascribed to Sir Isaac Newton—Victor Hehn was a genius. That his work needed correction as the years went by is to be expected. The work has been well done, and the line quoted by Prof. Schrader is well applied:—

"Was fruchtbar ist, allein ist wahr."—GOETHE."

J. H. T. W.

GENERAL SCIENCE.

Introduction to General Science, with Experiments.

By Percy E. Rowell. Pp. xxix+302. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 3s. 6d. net.

THE author of this book has a great belief in what he calls general science, which apparently amounts to a slight knowledge of many sciences. A pupil who knows a little about a great many subjects will, he considers, be able to obtain a bird's-eye view of the whole ground of knowledge, and to reason from many points of view on the phenomenon of nature. Further, a general course of this kind should reach every pupil somewhere and stimulate his ambition to learn more of at least one subject. Thus in the three hundred or so pages of this little volume we find sections devoted to almost all known sciences, illustrated by 100 experiments, with cross references to a large number of textbooks and bulletins.

To say that the book is sketchy, incomplete, and not infrequently inaccurate is to make an obvious criticism applicable to any book of this kind. At the same time one must feel sympathy with the object of the author and admiration for his courage in tackling so formidable a list of subjects and writing about them. He usually confines himself to applications of science to the common things of daily life, and does not concern himself with great generalisations. A few experiments on combustion thus lead to oxygen, then to fuels, and so by easy transitions to blasting, animal heat, flames, first aid to the burnt, sterilisation, disinfectants, &c., throughout the book. Indeed, as the author says with some